structure in FIG. **9**, and FIG. **11** shows a structure **114** of the BJT **106**. As shown, a conductive layer **116** is formed on the N-type diffusion region **82** and electrically contacts the N-type diffusion region **82** to act as the emitter (E) of the BJT **106**, a conductive layer **118** is formed on the P-type diffusion region **80** and electrically contacts the P-type diffusion region **80** to act as the base (B) of the BJT **106**, and a conductive layer **120** is formed on the N-type diffusion region **58** and electrically contacts the N-type diffusion region **58** to act as the collector (C) of the BJT **106**. The junction between the P-type diffusion region **80** and the N-type epitaxial layer **62** constitute a diode **112**, and resistor **110** is referred to the substrate resistor. When the pad **104** suffers an ESD event, along with the rising voltage, the diode **112** breaks down, the breakdown current flows through the resistor **110** to pump the substrate voltage, and thereby the BJT **106** is turned on to release the ESD current from the pad **104**.

[0005] The above-mentioned arts show that the conventional ESD protection devices achieve the goal of ESD protection by producing an increasing current resulted from the PN junction breakdown to trigger the BJT to turn on. However, the breakdown voltage of a PN junction depends on the dopant concentration of the PN junction. In a semiconductor process, the PN junction breakdown voltage of an ESD protection device and that of the core circuit of the integrated circuit (IC) have no great difference, and thereby the ESD protection device can not protect the core circuit of the IC from damages effectively. Though there are already several improved methods to reduce the breakdown voltage of an ESD protection device, however, they are attained by changing the dopant concentration of the PN junction, and therefore it is often needed to increase the process steps and the process complexity accordingly. For example, U.S. Pat. No. 5,559,352 to Hsue et al. discloses an ESD protection device improvement, which adds a step of lightly ion implantation to reduce the junction breakdown voltage. Furthermore, the holding voltage of an ESD protection device is required higher than the power source voltage VCC, in order to protect the core circuit of an IC from ESD damages. However, conventionally, due to the power source voltage VCC (for example 24V) of a high voltage CMOS (HV-CMOS) device always higher than the holding voltage (for example 13V), the HV-NMOS device or the HV-PMOS device can not operate in the breakdown region. When an ESD event occurs, the ESD protection device is not only unable to protect the HV-CMOS device but also causes the power of the HV-CMOS device short to ground, resulting in damages to the circuit.

[0006] Therefore, it is desired an ESD protection device without increasing the process steps and capable of applying to HV-CMOS device.

SUMMARY OF THE INVENTION

[0007] An object of the present invention is to provide an ESD protection device without increasing the process steps and capable of applying to HV-CMOS device.

[0008] According to the present invention, an ESD protection device comprises a substrate of a first conductivity type having a well of the first conductivity type, a first high concentration diffusion region of the first conductivity type, a second high concentration diffusion region of a second conductivity type opposite to the first conductivity type, a third high concentration diffusion region of the second conductivity type, and a fourth high concentration diffusion region of the first conductivity type all in the well, a first conductive layer electrically connecting to the first and second high concentration diffusion regions, and a second conductive layer electrically connecting to the third high concentration diffusion region. By altering the distance between the third and fourth high concentration diffusion regions, the breakdown voltage of the ESD protection device is adjusted.

[0009] According to the present invention, an ESD protection device comprises a substrate of a first conductivity type having a well of the first conductivity type, a first high concentration diffusion region of the first conductivity type, a second high concentration diffusion region of a second conductivity type opposite to the first conductivity type, a third high concentration diffusion region of the second conductivity type, and a fourth high concentration diffusion region of the first conductivity type all in the well, a gate above a channel between the second and third high concentration regions, a first conductive layer electrically connecting to the first and second high concentration diffusion regions, and a second conductive layer electrically connecting to the third high concentration diffusion region. By altering the distance between the third and fourth high concentration diffusion regions, the breakdown voltage of the ESD protection device is adjusted.

[0010] According to the present invention, an ESD protection device comprises a substrate of a first conductivity type, an epitaxial layer of a second conductivity type opposite to the first conductivity type on the substrate, a first diffusion region of the first conductivity type and a second diffusion region of the second conductivity type in the epitaxial layer, a third diffusion region of the second conductivity type in the first diffusion region, and a fourth diffusion region of the second conductivity type extending from the second diffusion region to a portion of the epitaxial layer between the first and second diffusion regions. By altering the distance between the first and fourth diffusion regions, the breakdown voltage of the ESD protection device is adjusted.

[0011] According to the present invention, an ESD protection device comprises a substrate of a first conductivity type having a first well of the first conductivity type and a second well of a second conductivity type opposite to the first conductivity type adjacent to each other, a first high concentration diffusion region of the first conductivity type in the first well, and a second high concentration diffusion region of the second conductivity type in the second well. By altering the distance between the first and second high concentration diffusion regions, the breakdown voltage of the ESD protection device is adjusted.

[0012] In a structure of the present invention, it is the distance between two diffusion regions of opposite conductivity types used to reduce the junction breakdown voltage of the ESD protection device. Without increasing the process steps, it solves the problems of the conventional techniques and is capable of utilizing in HV-CMOS device.

BRIEF DESCRIPTION OF DRAWINGS

[0013] These and other objects, features and advantages of the present invention will become apparent to those skilled in the art upon consideration of the following description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings, in which: